PATENT SPECIFICATION

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COMPLETE SPECIFICATION

Improvements in or relating to Electric Motors

(Communication from LEAR AVIA, INC., a corporation organized under the laws of the State of Illinois, United States of America, of Piqua, State of Ohio, United States of America).

I, ARTHUR HAROLD STEVENS, a British Subject, of the Firm of Stevens, Langner, Parry & Rollinson, Chartered Patent Agents, of 5/9, Quality Court, Chancery Lane, London, W.C.2, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to electric motors particularly useful for aircraft installations where maximum efficiency, simplicity, minimum weight and compactness are at a premium.

According to the invention there is provided an electric motor comprising a series of stator laminations of substantially the same size and shape having projecting portions adapted to act as heat radiating surfaces and so arranged that the projections of successive groups of laminations extend alternately in different directions, and end rings of similar cross-sectional shape arranged at each end of the series of laminations and secured thereto, the outermost edges of the projections having substantially the same width and cross-sectional shape as the end rings so that said projections and rings provide a substantially uniform exterior surface for the motor.

The invention arrangement affords a substantially increased heat radiating surface, resulting in increased operating efficiencies over motors of comparable prior types and size.

The cross-section of the motor components are the same for different motor sizes, different motor ratings being accomplished by varying only the overall motor length. The invention is practicable for motors either of the direct current or alternating current types, and is particularly advantageous where compact highly efficient motors are required, as aboard an aircraft. Most of the motors used on an aircraft are of the intermittent type. A given maximum power output can be provided for such intermittent duty by a motor of much smaller size and weight than previously available, where the heat radiation feature of my invention is incorporated.

In order that the invention may be clearly understood and readily carried into effect the same will now be described more freely with reference to the accompanying drawing in which:—

Fig. 1 is a perspective illustration of a motor embodying the principles of the invention.

Fig. 2 is a horizontal cross-section through the motor, taken along the line 2—2 of Fig. 1.

Fig. 3 is a vertical cross-section through the motor, taken along the lines 3—3 of Fig. 2.

Fig. 4 is a plan view of a stator lamination of the motor.

Fig. 5 is a perspective view of a series of stator laminations.

The motor of the invention is compact and designed with a minimum weight and bulk for a given power rating. The motor is constructed with components of a simplified form and assembly, resulting in a motor that is readily serviced, maintained and repaired, and relatively inexpensive to manufacture, without sacrifice in stability, durability or the reliability required of aircraft motors. By providing a very efficient radiating arrangement, the invention motor may be operated at higher current and power ratings than comparable motors of given dimensions and wire size.

The invention is illustrated in connection with a direct current type of motor. However, it is to be understood that it is equally applicable to motors of the alternating current variety. The illustrated motor comprises a stator constructed with two similar end rings 10, 11, with a series of stator laminations 12 secured between them. The end rings and laminations are formed into an integral unit by four pins 15, the heads of which are riveted over. Stator windings 16 are arranged within end rings 10, 11. Circular coil wedges 17 of insulating material are fitted against the inner surface of windings 16,

[Price 1/-]

contiguous with the inner edges 18 of stator laminations 12. A continuous circular region is accordingly afforded within the stator to accommodate the rotor or armature 20.

Armature 20 comprises a series of slotted rotor laminations 21 with the usual armature winding 22, and a commutator 23. The axial length of the series of rotor laminations 21 is preferably equal to the axial length of stator lamination series 12, as shown in Fig. 2. Efficient electromagnetic coupling and motor operation is accordingly afforded between the rotor and stator laminations, with a minimum of eddy current and hysteresis losses and heating. Commutator and bell 24 contains a bearing sleeve 25 in which a sealed ball-bearing 26 is mounted, rotatably supporting one end 27 of the rotor shaft 28. End bell 24 is preferably an aluminum casting for lightness, with bearing sleeve 25 pressed into it. End bell 24 is fitted against end ring 10 and secured thereto by screws 29. A cover plate 30 is attached to the end of commutator end bell 24, protecting the bearing and the corresponding opening in the bell from the exterior.

A drive shaft end bell 31 is fitted against the open end of stator end ring 11 and secured thereto by screws 32. Bell 31 is also preferably an aluminum casting into which a bearing housing or sleeve 33 is pressed. A sealed ball-bearing is mounted within sleeve 33 in which a rotor bearing 34 is mounted rotatably supporting drive shaft 28 of the rotor 20. The usual brushes are provided for commutator 23, supported in diametrically opposed holders 35 (Fig. 1). The brushes and stator windings 16 are connected in the desired circuital relation. External electrical connection is made to the motor through leads 36 projecting from opening 37 in end bell 31.

An important feature of the present invention resides in the arrangement of the stator plates to provide efficient heat radiation for the motor. The stator lamination series 12 is arranged with spaced cooling fins 40 projecting from the motor assembly. The cooling fins 40 provide an increased radiating surface for dissipating heat generated by the motor. The stator lamination plates are all of identical size and shape. Fig. 4 is a plan view showing a single lamination plate 41. The lamination plates 41 are generally of a rectangular shape, with one side 42 thereof projecting beyond the normal rectangular form. The interior of laminations 41 are stamped out in an outline which is symmetrical along both the vertical and horizontal axes, for simplifying their alignment as a stator.

The projections 42 of each stator lamination 41 compose cooling fins 40 when stacked together as shown in Fig. 5. In practice, five or six laminations are grouped together to form a section corresponding to a fin 40. It is, of course, to be understood that a larger or smaller number of lamination plates may be so grouped, depending upon design requirements or preferences. Successive lamination groups are arranged with their projecting portions 42 disposed 180° apart, i.e. on opposite sides, as illustrated in Figs. 2 and 5. In this manner only a single type and size of lamination plate 41 need be stocked or otherwise used in assembling or servicing the motors, regardless of their rating, or length. The projecting cooling fins 40 effectively dissipate the heating of the motor, permitting a higher power output rating for a given motor size.

Motors of different ratings are readily constructed with the same components. The simplified motor construction of the invention permits motors to be assembled in any practicable desired length, using components of the same cross-section. The range of ratings and sizes of the motors is accomplished by selecting the length of its stator lamination series 12, and the corresponding lamination series 21 of its rotor. End rings 10, 11, and end bells 24, 31, are the same for all the motors, as are the individual laminations for the stators and rotors. When it is desired to build a motor of greater rating, it is simply necessary to stack the stator and rotor laminations into a series of greater length; for smaller ratings, the length is correspondingly smaller.

The laminations are stacked in alignment on a suitable mandril, and compressed between end rings 10, 11 with riveted pins 15, resulting in a solid integral stator unit of predetermined length. The stator windings 16 are then inserted within the respective end rings, and between the slots 45 in the stator laminations. Coil wedges 17 are thereupon mounted in position, completing the solid, rugged stator unit. The armature is similarly constructed to its requisite length, with the central laminated section 21 corresponding in length to the length of the stator lamination series 12. The different motor sizes are accordingly all manufactured with a minimum of components of distinct type, size or dimension. This materially facilitates maintenance and servicing of the different sized motors.

The wire used for windings 16 and 22 is preferably coated with glass enamel and

insulated with fiber glass, permitting higher safe operating temperatures. After the windings are formed, they are vacuum impregnated and slowly baked at a high temperature, resulting in a solid insulated body. Also the minimizing of voids in the motor and windings reduces the possibility of movement of the windings in service, particularly the stator windings, and the resultant danger of damage to the insulation. The cooling fins 40 constitute a substantial portion of the motor framework, and effectively dissipate the motor heat. The combination with the other advantages, permits efficient operation of the motor at much higher temperatures than heretofore practicable.

Motors designed in accordance with the present invention have intermittent duty ratings of very high efficiencies. For example, fractional horse power direct current motors constructed in accordance with the invention, operate in service at efficiencies of the order of 80 to 85%; and similar motors with ratings above one horse power, having even greater efficiencies, e.g. above 90%. The high efficiency, lightweight, and compactness of the invention motors obviously render them most advantageous to use in modern aircraft.

Although only one embodiment of the invention has been set forth herein in detail, it is to be understood modifications may be made falling within the broader spirit and scope of the invention as set forth in the following claims.

Having now particularly described and ascertained the nature of my said invention, (as communicated to me by my foreign correspondents), and in what manner the same is to be performed, I declare that what I claim is:—

1. An electric motor comprising a series of stator laminations of substantially the same size and shape having projecting portions adapted to act as heat radiating surfaces and so arranged that the projections of successive groups of laminations extend alternately in different directions and end rings of similar cross-sectional shape arranged at each end of the series of laminations and secured thereto, the outermost edges of the projections having substantially the same width and cross-sectional shape as the end rings so that said projections and rings provide a substantially uniform exterior surface for the motor.

2. An electric motor according to claim 1 in which laminations forming the series have a projection on one side only and are stacked with the projections of successive groups extending alternately in diametrically opposite directions.

3. An electric motor according to claim 1, in which the laminations are generally rectangular in shape with one side of each lamination projecting beyond its basic rectangular form, the projecting sides of one group extending at an angle of 180° to the projecting sides of the adjacent group.

4. An electric motor according to any one of the preceding claims, including a pair of end bells each secured to one of the end rings, and an armature rotatably supported in the end bells.

5. An electric motor according to any one of the preceding claims, in which the stator laminations are formed with substantially circular cutouts to receive an armature and with oppositely disposed recesses to receive a stator winding.

6. The electric motor substantially as hereinbefore described with reference to Figs. 1 to 5 of the accompanying drawings.

Dated this 24th day of November, 1943.
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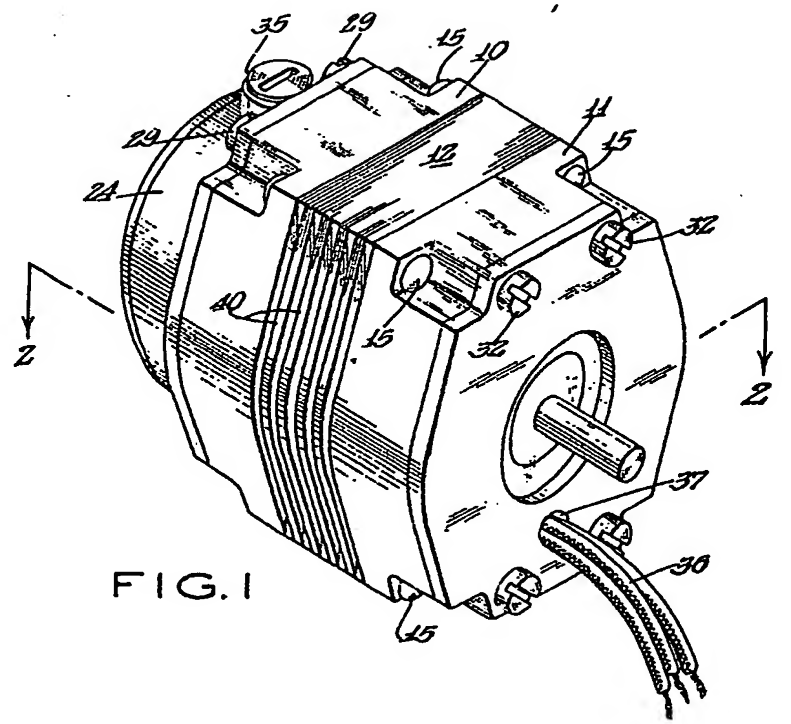
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FIG. 1

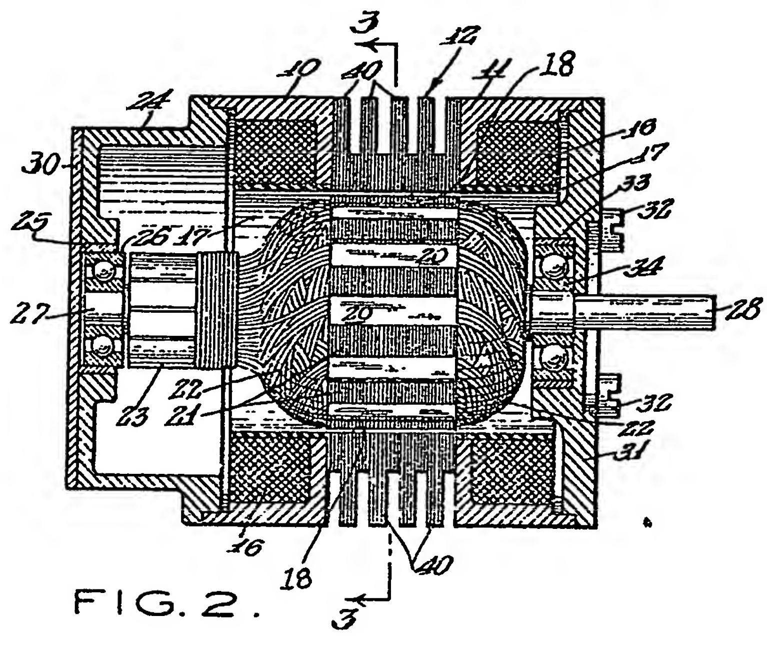
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FIG. 2.


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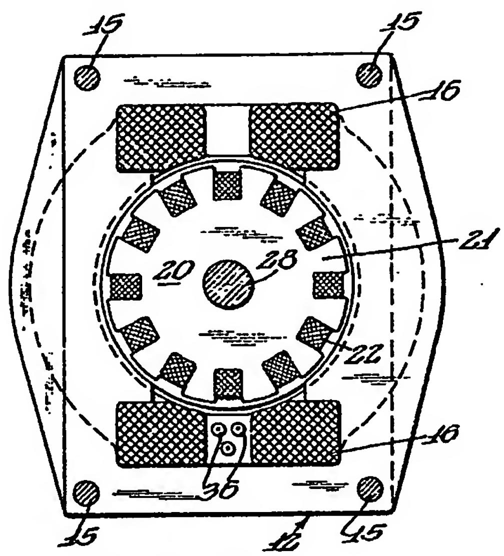

FIG. 3.

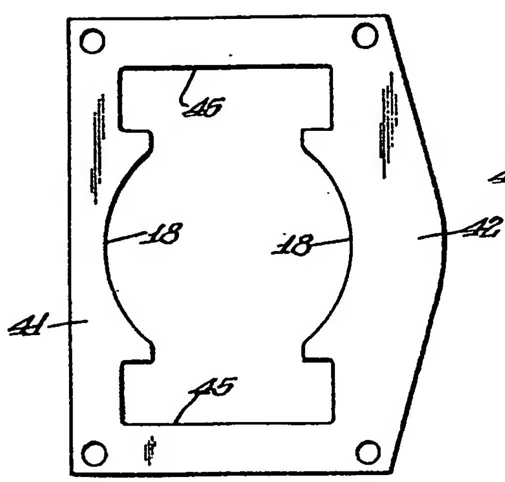

FIG. 4.

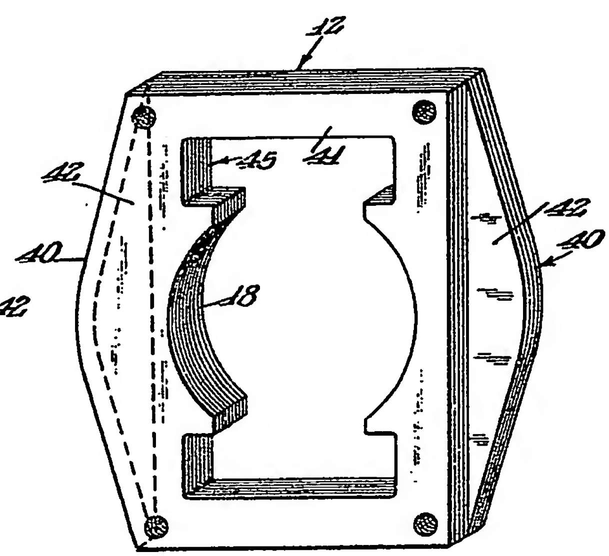

FIG. 5.

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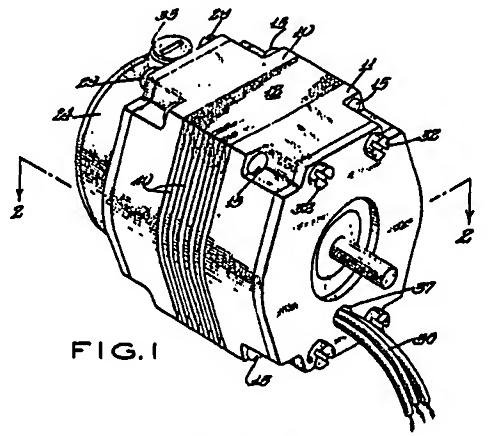

FIG. 1

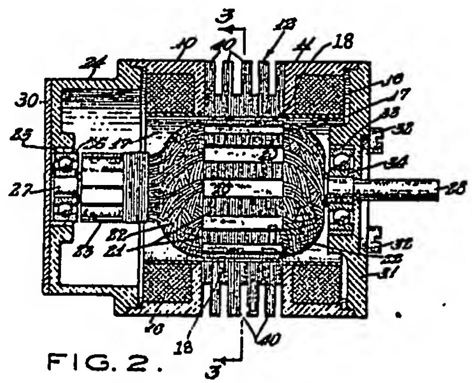

FIG. 2.

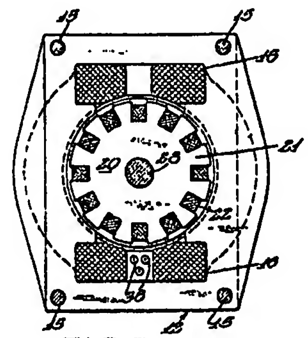

FIG. 3.

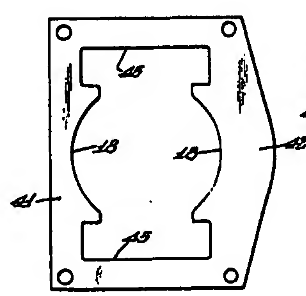

FIG. 4.

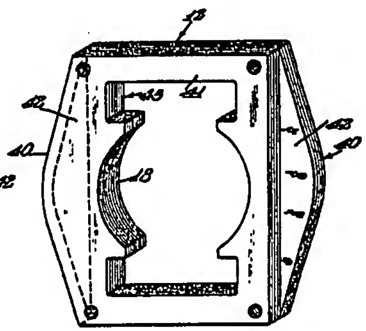

FIG. 5.